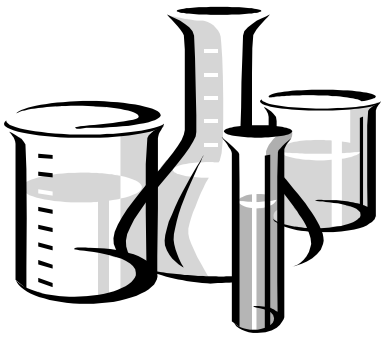
United States Environmental Protection Agency
Office of Prevention, Pesticides And Toxic Substances (7510P)
EPA 712-C-07-091 Draft November 5, 2009

EPA

Product Performance Test Guidelines

OPPTS 810.2300: Sanitizers for Use on Hard Surfaces—Efficacy Data Recommendations



Public Review Draft

NOTICE

This guideline is one of a series of test guidelines established by the Office of Prevention, Pesticides and Toxic Substances (OPPTS), United States Environmental Protection Agency for use in testing pesticides and chemical substances to develop data for submission to the Agency under the Toxic Substances Control Act (TSCA) (15 U.S.C. 2601, et seq.), the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. 136, et seq.), and section 408 of the Federal Food, Drug, and Cosmetic (FFDCA) (21 U.S.C. 346a).

The OPPTS test guidelines serve as a compendium of accepted scientific methodologies and protocols that are intended to provide data to inform regulatory decisions under TSCA, FIFRA, and/or FFDCA. This document provides guidance for conducting the test, and is also used by EPA, the public, and the companies that are subject to data submission requirements under TSCA, FIFRA and/or the FFDCA. As a guidance document, these guidelines are not binding on either EPA or any outside parties, and the EPA may depart from the guidelines where circumstances warrant and without prior notice. The procedures contained in this guideline are strongly recommended for generating the data that are the subject of the guideline, but EPA recognizes that departures may be appropriate in specific situations. You may propose alternatives to the recommendations described in these guidelines, and the Agency will assess them for appropriateness on a case-by-case basis.

For additional information about OPPTS harmonized test guidelines and to access the guidelines electronically, please go to http://www.epa.gov/oppts and select "Test Methods & Guidelines" on the left side navigation menu. You may also access the guidelines in http://www.regulations.gov grouped by Series under Docket ID #s: EPA-HQ-OPPT-2009-0150 through EPA-HQ-OPPT-2009-0159, and EPA-HQ-OPPT-2009-0576.

OPPTS 810.2300: Sanitizers for use on hard surfaces - efficacy data recommendations.

(a) Scope

(1) Applicability. This guideline is intended to meet testing requirements of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7U.S.C. 136, et seq.), and the Federal Food, Drug, and Cosmetic Act (FFDCA) (21 U.S.C. 346a). It addresses testing to demonstrate effectiveness of products which are sanitizers.

(2) Background. The source materials used in developing this OPPTS test guideline are OPP guidelines 91-2: Products for use on hard surfaces and 91-30: Acceptable methods (Pesticide Assessment Guidelines, Subdivision G, Product Performance. EPA report 540/9-82-026, October 1982).

(b) Purpose. This guideline addresses efficacy testing for antimicrobial pesticides intended to be used on hard surfaces, namely sanitizers in a variety of product types (water-soluble powders, liquids, sprays, towelettes, etc.).

(c) General considerations

(1) This guideline recommends tests to be conducted and data to be submitted which the Agency believes will generally satisfy the requirements for pesticide registration. Studies conducted under this guideline should be completed under EPA's Good Laboratory Practice regulations (40 CFR Part 160). Note: The Association of Official Analytical Chemists (AOAC) recommended tests are expected to be conducted as written. For deviations (e.g., cultures grown with shaking instead of static, dilution of culture prior to drying on carriers) proposed to be used in the conduct of these tests, obtain written approval from the Agency and document such deviations in the study reports submitted to the Agency. The Agency may consult with the AOAC prior to accepting modification to their standardized methods. Refer to OPPTS Test Guideline 810.2000 for general testing recommendations prior to initiating tests.

(2) Confirmatory testing. In certain situations an applicant may rely on previously submitted efficacy data to support an application or amendment for registration of a product and submit only confirmatory efficacy data on his own product to demonstrate his ability to produce an effective formulation. These situations are as outlined in paragraphs (c)(2)(i) and (c)(2)(ii) in this guideline**.**

(i) Duplicated Product Formulations. In this situation, the applicant manufactures a formulation which duplicates a product that is already registered with complete supporting efficacy data. The chemical composition, manufacturing procedure, label claims, and directions for use are identical in substance to those of the original registration, and specific references (Master Record ID Numbers [MRIDs]) to the supporting data developed for the original product are cited by the applicant.

(ii) Minor Formulation Change in a Registered Product. In this situation, the change in the formulation is relatively minor, e.g., a change of an inert ingredient. The label claims and

directions for use are unchanged from those accepted for the registered formulation, and specific references (MRIDs) to the supporting data developed for the original formulation are cited by the applicant. The confirmatory data should be developed on the applicant's own finished product. When the test methodology utilized in deriving the original supporting efficacy data were modified to include additional elements not specified in the recommended method, such as organic soil, hard water, longer or shorter contact time, etc., the confirmatory data should be produced under similarly modified conditions.

(3) Table 1 provides a quick reference guide to testing for basic claims described in this guideline. Consult the text for detailed testing descriptions.

Table 1. Tests for basic claims described in this guideline.

Level of Efficacy	Test Methods		Test Organisms	No. of Batches/Carriers	Evaluation of Success
Non-food Contact Sanitizer	Water soluble powders/liquids Spray products	EPA Sanitizer Test or ASTM E-1153-03	*Staphylococcus aureus* (ATCC 6538) and *Klebsiella pneumoniae* (ATCC 4352) *Enterobacter aerogenes* (ATCC 13048) may be substituted for *K. pneumoniae*.	Three batches, one at least 60 days old.	99.9% reduction within 5 minutes.
	Towelettes	Reserved			
Food Contact Surface Sanitizer Halide Products	Water soluble powders/liquids	AOAC International Chlorine (Available) in Disinfectants Germicidal Equivalent Concentration	*Salmonella typhi (ATCC 6539) or S. aureus (ATCC 6538)*	Three batches, one at least 60 days old.	Test results should demonstrate product concentrations equivalent in activity to 50, 100, and 200 ppm of available chlorine.
Food Contact Surface Sanitizer Non-Halide Products	Water soluble powders/liquids	AOAC International Germicidal and Detergent Sanitizing Action of Disinfectants	*Escherichia coli (ATCC 11229) and S. aureus (ATCC 6538)*	Three batches, one at least 60 days old.	99.999% reduction in the number of each test microorganism within 30 seconds.
	Towelettes	EPA Test			
Sanitizers for Urinal and Toilet Bowl Water and In-tank Sanitizers	Water soluble powders/liquids/tablets	Simulated-use study	*Enterococcus faecalis or Salmonella enterica*	Three batches.	99.9% reduction over parallel control counts.
Residual Self-sanitizing – wet surfaces		Simulated-use study	Representative gram positive and gram	Three batches, one at least 60 days old.	99.9% reduction over parallel control counts.

Level of Efficacy	Test Methods		Test Organisms	No. of Batches/Carriers	Evaluation of Success
			negative organisms		

(d) Sanitizers for nonfood contact surfaces (water soluble powders, liquids, and spray products). These products, when used as directed, should reduce the number of test microorganisms on a treated surface over those of an untreated control surface. The following testing recommendations apply to products bearing label claims for effectiveness as sanitizers for inanimate hard surfaces other than those which come in contact with food or beverages (e.g., floors, walls, furnishings).

(1) Test Procedures.

(i) The Agency recommends the test procedures in this paragraph: The Sanitizer Test for Inanimate Non-food Contact Surfaces (prepared by the Registration Division, Office of Pesticide Programs, EPA, 1976) (Ref. 1). The propagation of cultures and the use of subculture media and other related equipment may be as specified in Official Methods of Analysis of AOAC International, Chapter 6, Disinfectants (Ref. 3). Three product samples, representing three different batches, one of which should be at least 60 days old, should be tested against each test bacterium on each representative test surface depending on the uses proposed on the label (for hard, porous surface label claims use unglazed ceramic tile) (for hard, nonporous surface label claims use stainless steel carriers or glass slides), using 5 test carriers and 3 control carriers. The test microorganisms are: *Staphylococcus aureus* (*S. aureus*) (ATCC 6538) and *Klebsiella pneumoniae* (*K. pneumoniae*) (ATCC 4352). *Enterobacter aerogenes* (*E. aerogenes*) (ATCC 13048) may be substituted for *K. pneumoniae*. The test elements in paragraphs (d)(1)(A) through (d)(1)(I) of this paragraph should be used.

(A) Determine the bacterial count in an 18-24 hour broth culture and add a 0.01- 0.03 mL quantity of the broth culture by spreading on a 1 x 1 inch square of test surface using a bacteriological loop.

(B) If the product is intended to be represented as a cleaner-sanitizer, an organic soil load, such as 5 percent blood serum, should be added to the bacterial inoculum.

(C) The square of test surface should be dried for 40 minutes in a bacteriological incubator at 30- 37 °C.

(D) A zero-time bacterial numbers recovery test (dried carrier count) should be performed to demonstrate the efficiency of the recovery process and should be reported. The "zero-time" test is intended to show the loss in viability that occurred during carrier drying.

(E) Apply the product to the inoculated test surfaces as directed on the product label.

(F) Run parallel tests on the formulation with the active ingredients omitted in an identical manner to serve as the control. If such a control solution is not suitable, use sterile distilled water to which may be added 0.01percent isooctylphenoxypolyethoxyethanol (9-10

moles oxyethylene, e.g., Triton X-100).

(G) After the label recommended exposure time, recover the test organisms by washing the squares with agitation in media or dilution fluid containing neutralizers

(H) Make plate counts on nutrient agar containing the same neutralizers by the pour or spread plate technique.

(I) Exposure time intervals between 0-time and 5 minutes should be tested for the product as well as the untreated controls.

(ii) The American Society for Testing and Materials (ASTM) Test Method for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces (E1153-03) may be used (Ref. 2). Three product samples, representing three different batches, one of which should be at least 60 days old, should be tested against each test bacterium on each representative test surface depending on the uses proposed on the label. (for hard, porous surface label claims use unglazed ceramic tile) (for hard, nonporous surface label claims use stainless steel carrier or glass slide), using 5 test carriers and 3 control carriers. The test microorganisms are: (*S. aureus*) (ATCC 6538) and (*K. pneumoniae*) (ATCC 4352). *E. aerogenes* (ATCC 13048) may be substituted for *K. pneumoniae*. The ASTM method states that the inoculum employed should provide a count of at least 7.5×10^5 colony forming units per carrier.

(iii) Evaluation of sanitizing success for nonfood contact surface sanitizers. The results should demonstrate a reduction of at least 99.9% (a 3-log reduction) in the number of each test microorganism over the parallel control count within 5 minutes.

(e) Towelettes. (Reserved.)

(f) Sanitizers for Internal Toilet and Urinal Bowl Surfaces Above and Below the Water Line

(1) Test Procedures. The Agency recommends the use of the Sanitizer Test for Inanimate Non-food Contact Surfaces (prepared by the Registration Division, Office of Pesticide Programs, EPA, 1976) (Ref. 1), or The American Society for Testing and Materials (ASTM) Test Method for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces (E1153-03) may be used (Ref. 2). The contained bowl water (96 fl oz) should used to calculate the appropriate use dilution for testing.

(2) Evaluation of sanitizing success for toilet and urinal bowl surface sanitizers. The results should demonstrate a reduction of at least 99.9% (a 3-log reduction) in the number of each test microorganism over the parallel control count within 5 minutes.

(g) Sanitizing rinses (soluble powders and liquids) for previously cleaned food-contact surfaces. This section addresses efficacy testing for products with a label recommendation for the treatment of previously cleaned, nonporous, food contact surfaces (e.g., eating and drinking utensils and food processing equipment) as a terminal sanitizing rinse.

(1) Halide chemical products. Sanitizing rinses formulated with iodophors, mixed halides, and chlorine-bearing chemicals.

(i) Test procedure. The Agency recommends the AOAC International Chlorine (Available) in Disinfectants Germicidal Equivalent Concentration test (Ref. 3). Three samples, representing three different batches, one of which should be at least 60 days old, should be evaluated for efficacy against *Salmonella enterica* (*S. enterica*) (formerly Salmonella typhi) (ATCC 6539) or *S. aureus* (ATCC 6538). When claims are made for the effectiveness of the product in hard water, all data should be developed at the hard water tolerance claimed.

(ii) Evaluation of sanitizing success of halide formulations. Test results should demonstrate product concentrations equivalent in activity to 50, 100, and 200 ppm of available chlorine. The reference standard is sodium hypochlorite.

(2) Confirmatory testing for halide chemical products

(i) Test procedure. The Agency recommends the AOAC International Chlorine (Available) in Disinfectants Germicidal Equivalent Concentration test (Ref. 3). One sample should be evaluated for efficacy against *S. enterica* (ATCC 6539) or *S. aureus* (ATCC 6538). When claims are made for the effectiveness of the product in hard water, all data should be developed at the hard water tolerance claimed.

(ii) Evaluation of sanitizing success of halide formulations. Test results should demonstrate product concentrations equivalent in activity to 50, 100, and 200 ppm of available chlorine. The reference standard is sodium hypochlorite.

(3) Non-halide chemical products. Sanitizing rinses formulated with quaternary ammonium compounds, chlorinated trisodium phosphate, and anionic detergent-acid formulations.

(i) Test procedure. The Agency recommends the AOAC International Germicidal and Detergent Sanitizing Action of Disinfectants test (Ref. 4). Three samples, representing three different batches, one of which should be at least 60 days old, should be evaluated for efficacy against both *Escherichia coli (E.coli)* (ATCC 11229) and *S. aureus* (ATCC 6538). When claims are made for the effectiveness of the product in hard water, all data should be developed at the hard water tolerance claimed.

(ii) Evaluation of sanitizing success of non-halide formulations. Acceptable results should demonstrate a 99.999% reduction in the number of each test microorganism within 30 seconds. The results should be reported according to the actual count and percentage reduction over the control.

(4) Confirmatory testing for non-halide products—(i) Test procedure. The Agency recommends the AOAC International Germicidal and Detergent Sanitizing Action of Disinfectants test (Ref. 4). One sample should be evaluated for efficacy against both *E. coli* (ATCC 11229) and *S. aureus* (ATCC 6538). When claims are made for the effectiveness of the product in hard water, all data should be developed at the hard water tolerance claimed.

(ii) Evaluation of sanitizing success of non-halide formulations. Acceptable results should demonstrate a 99.999% reduction in the number of each test microorganism within 30 seconds. The results should be reported according to the actual count and percentage reduction over the control.

(h) Towelette Sanitizers for Food Contact Surfaces. This section addresses efficacy testing for products with a label recommendation for the treatment of hard, non-porous surfaces which may come into contact with food. Food Contact Surface (FCS) towelettes are intended to be used to sanitize the following surfaces: hard non-porous tables, countertops (stainless steel, laminated, sealed ceramic,) stove tops, interior and exterior surfaces of microwaves and refrigerators. FCS towelettes may not be used to sanitize the following food contact surfaces: utensils, glasses, food containers, dishes, cutting boards, cutting blocks, drain boards, and food processing equipment. This list is not meant to be all-inclusive, but to serve as general guidance for the appropriate use of this type of antimicrobial pesticide. The Agency reserves the right to accept or deny use sites for food contact surface towelettes on a case-by-case basis.

(1) Test Procedure. The Agency recommends the use of the Interim Guidance for Non-Residual Sanitization of Hard Inanimate Food Contact Surfaces Using Pre-Saturated Towelettes. This guidance may be found at: http://www.epa.gov/oppad001/towelette.htm

Three samples, representing three different batches, one of which is at least 60 days old, should be evaluated for efficacy against *E. coli* (ATCC 11229) and *S. aureus* (ATCC 6538).

(2) Evaluation of towelette sanitizing success. The product should demonstrate at least a 99.999% reduction in the number of test microorganisms (bacteria) within 30 seconds. The result should be reported according to the actual count and percentage reduction over the control.

(i) Sanitizers for Toilet and Urinal Bowl Water. This section addresses efficacy testing for products with claims as sanitizers for toilet and urinal bowl water.

(1) Test Procedure. A simulated-use study should be designed which incorporates all of the elements listed in paragraphs (i)(1)(i) through (i)(1)(iv) in this guideline.

(i) The product should be added to samples of the bowl water from three toilets or urinals at the use concentration employing the recommended method of dispensing. Untreated control samples from the three toilets or urinals should also be included.

(ii) Whether the product is automatically metered, or dispensed in some other fashion, into the bowl water (or urinal trap), the consistent accuracy of the concentration dispensed and maintained should be documented.

(iii) Inocula containing representative Gram-positive or Gram-negative test bacteria should be added to the treated and control samples of the bowl water from each of the toilets or urinals to provide a concentration of at least 10^4 colony-forming units per milliliter.

(iv) Microbial counts of the treated bowl water and the control bowl water should be conducted at a minimum of three exposure intervals, in addition to a 0-time control.

(2) Evaluation of Sanitizing Success. The reduction of each test microorganism should be at least 99.9% over the 0-time control and the parallel untreated inoculated control.

(j) In-Tank Sanitizers. This section addresses efficacy testing for products which bear label claims for use as an automatically dispensed in-tank sanitizer.

(1) Test Procedures. In-tank sanitizer products should be evaluated by a preliminary simulated-use test followed by a laboratory efficacy test. These tests should incorporate the elements in paragraphs (j)(1)(i) through (j)(1)(i)(B).

(i) Preliminary simulated-use test. The use-life of the in-tank product should be documented for three product samples, each in a separate toilet under the conditions in paragraphs (j)(1)(i)(A) and (j)(1)(i)(B) of this guideline simulating actual usage. Testing conducted with a 6 gallons/flush toilet may be used to generate data for low flush toilets (3.5 gallons/flush).

(A) Number of flushes (dispensation of the dosage) per day per X weeks (duration of effectiveness) with a non-chlorinated water supply at 25-30 °C (the warm water temperature extreme in summer).

(B) The bowl water should be analyzed at periodic intervals during the testing indicated in paragraph (j)(1)(i)(A) in this guideline to demonstrate the pH and concentration of the active ingredients.

(ii) Laboratory efficacy tests. Bacteriologic assays should be conducted on neutralized treated and untreated samples by standard plating procedures employing:

(A) Samples of the residual bowl water from three toilets (at the minimal use concentration) and corresponding untreated control samples from three toilets at 10-.15 °C (the most stringent water temperature for demonstrating efficacy).

(B) Representative Gram-positive and Gram-negative bacteria (e.g., *Enterococcus faecalis, Salmonella enterica)* with an inoculum of at least 10^4CFU/mL.

(C) A minimum of three exposure intervals, in addition to a 0-time control.

(iii) Evaluation of in-tank sanitizing success. The reduction of each test microorganism should be at least 99.9% over the 0-time control and the parallel untreated inoculated control.

(k) Residual self-sanitizing activity of dried chemical residues on hard-inanimate surfaces - wet surfaces. This section addresses efficacy testing for products which bear label claims to provide residual self-sanitizing activity (e.g., significant reduction in numbers of infectious microorganisms which may be present or subsequently deposited) on treated surfaces

that are likely to become and remain wet under normal conditions of use.

(1) Test procedure. Residual self-sanitizing products for use on hard, inanimate surfaces should be evaluated for efficacy using a controlled in-use study or simulated in-use study. The design of the study should be done in consultation with the Agency and should include the basic elements: in paragraphs (k)(1)(i) through (k)(1)(vii) of this guideline.

(i) The test microorganisms employed in the study should be pathogens that are likely to be encountered in the environment in which the product is to be used.

(ii) The starting inocula of the test microorganisms for both initial and subsequent challenges should be of sufficient concentration to provide at least 10^4 survivors on the parallel control surface.

(iii) Subsequent challenges should be of sufficient frequency to accurately represent normal conditions of use.

(iv) Quantitative bacteriological sampling should be conducted at frequent and regular intervals for the length of time the residual activity can be expected to exist under the expected use conditions.

(v) The same types of surfaces without the treatment should be employed in the test and inoculated in a manner and over an exposure period identical to the use pattern for which the product is intended.

(vi) The environmental conditions (e.g., relative humidity and temperature) should be the same as those likely to be encountered under normal conditions of product use. Tests should also include those environmental conditions that would act to reduce the effective concentration of the product on the inanimate surface (e.g., rinsing, abrasion, organic load, repeated challenges by microorganisms, etc.).

(vii) The length of time the residual activity can be expected to exist under the expected use conditions should be documented.

(2) Evaluation of success of residual self-sanitizing action. For residual self-sanitizing claims, it should be demonstrated that a product is capable of reducing the number of test microorganisms on the test surface by 99.9% over that of the parallel control surfaces.

(l) Residual self-sanitizing activity of dried chemical residues on hard-inanimate surfaces - dry surfaces. This section addresses efficacy testing for products which bear label claims to provide residual self-sanitizing activity (e.g., significant reduction in numbers of infectious microorganisms which may be present or subsequently deposited) on treated dry surfaces.

(1) Test Procedure. The Agency recommends the use of the Protocol for Residual Self-Sanitizing Activity of Dried Chemical Residues on Hard Non-Porous Surfaces. This guidance

may be found at: http://www.epa.gov/oppad001/regpolicy.htm.

(2) Evaluation of residual self-sanitizing success. The product should demonstrate that it is capable of reducing the number of test microorganisms on the test surface by 99.9% over that of the parallel control surfaces within 5 minutes for a 24 hour period.

(m) Data collection and reporting

(1) General. To assist in the proper review and evaluation of product performance, complete descriptions of the test employed and the results obtained should be submitted to the Agency. All test reports should include, at the least, what is in paragraphs (m)(1)(i) through (m)(1)(xiv) of this guideline:

(i) Study title;

(ii) Product identity;

(iii) Guideline number;

(iv) Identification of the testing laboratory or organization;

(v) Location where the test was performed;

(vi) Name(s) of the person(s) responsible for the test;

(vii) Good Laboratory Practice compliance;

(viii) Purpose of the study;

(ix) Date and time of the start and end of the test;

(x) Statistical treatment of the data;

(xi) Conclusions;

(xii) References;

(xiii) Appendices;

(xiv) Certification.

The applicant is encouraged to use the EPA's standard efficacy report format, which may be found at http://www.epa.gov/oppad001/efficacystudystandards.htm

(2) Data for recommended methods. When recommended methods from the Official Methods of Analysis of AOAC International; the Annual Book of Standards of the American Society for Testing and Materials; or, EPA methods are used to develop efficacy data, certain

minimal information, in addition to that described in this guideline, should be provided in the test report. The report should include, but is not limited to, the material in paragraphs (m)(2)(i) through (m)(2)(xii) in this guideline:

(i) Test employed, and any modifications thereto (e.g., organic soil, hard water, etc);

(ii) Test microorganisms employed, including identification of the specific strain (ATCC or other);

(iii) Description of the test substance, including the percent of active ingredient;

(iv) Concentration or dilution of the product tested and how prepared;

(v) Number of samples, batches and replicates tested;

(vi) Preparation dates of each product batch (individually formulated preparation of the product);

(vii) Identification of all material or procedural options employed, where such choice is permitted or recommended in the test method selected (e.g., growth media, drying time for inoculated carriers, neutralization confirmation and/or subculture media, secondary subculturing);

(viii) Test exposure conditions (e.g., contact time, temperature, and relative humidity);

(ix) Complete reports of results obtained for each replication;

(x) Any control data essential to establish the validity of the test;

(xi) Carrier counts;

(xii) Any additional data pertinent for specific tests described in this guideline.

(3) Data for modifications of recommended methods. Where recommended methods are modified to support specific claims and/or use patterns for a product, the protocol, identifying and describing each modification, should be provided in specific detail with the test report. The applicant is encouraged to submit the proposed modification to the Agency for review and evaluation prior to initiation of the test.

(4) Data for other methods. When recommended methods, or modifications thereto, are not employed to develop efficacy data (such as actual in-use or many kinds of simulated-use testing), complete testing protocols should be submitted with the test reports. All materials and procedures employed in testing should be described in a manner consistent with original research reports published in technical or scientific journals. Where references to published reports or papers are made, copies or reprints of such references should be provided with the test reports. The applicant should to submit the proposed testing protocols for in-use or simulated-use studies to the Agency for review and evaluation prior to initiation of the test.

(n) References: The following references may be consulted for additional background information:

(1) Environmental Protection Agency, *Sanitizer Test for Hard, Inanimate Nonfood Contact Surfaces Modified to Include Organic Soil*. (Registration Division, Office of Pesticide Programs, 1976).

(2) *Annual Book of Standards*, Test Method for Efficacy of Sanitizers Recommended for Inanimate Non-Food Contact Surfaces, Designation E1153-03. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

(3) *Official Methods of Analysis of the AOAC International*, Chapter 6, Disinfectants, Official Method 955.16 Chlorine (Available) in Disinfectants, Germicidal Equivalent Concentration. Eighteenth edition. AOAC International, Suite 500, 481 North Frederick Avenue, Gaithersburg, MD 20877-2417.

(4) *Official Methods of Analysis of the AOAC International*, Official Method 960.09 Germicidal and Detergent Sanitizing Action of Disinfectants. Eighteenth edition. AOAC International, Suite 500, 481 North Frederick Avenue, Gaithersburg, MD 20877-2417.